jSEAGULL

a Java Simulation Engine for Agent Graph Understanding in Local Lattices

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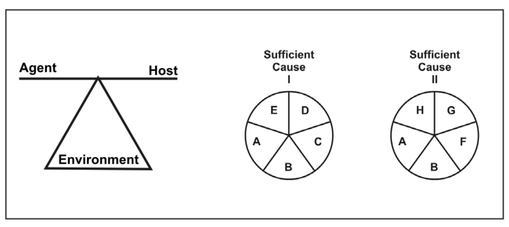
Introduction

Facebook, Twitter, Pinterest and Linkedin. Are we mentioning common websites or something more? According to current trends, a Social Network is not only a way to keep in touch with friends but it could be considered as an ordinary place where people walks in and start living. Keeping in mind this scenario, what happens if one tries to push a piece of news into the network in order to reach the maximal audience within the least amount of time? Predicting how a piece of news can propagate inside a Social Network is quite challenging since it depends on many factors like its content, the users elected to start its spread, the topology of the network, the interest rates of the exposed users along with their sharing behaviour and so forth. For this purpose we introduce jSeagull, a Java Simulation Engine for Graph Understanding in Local Lattices, which provides publicists and companies with a powerful tool for studying content spread within social networks.

Epidemiology

We are dealing with an epidemiological problem where the susceptible agents are impersonated by the social network users whereas the piece of news to be propagated plays the role of the epidemic. Specifically, a user is infected if he believes on the piece of news once received.



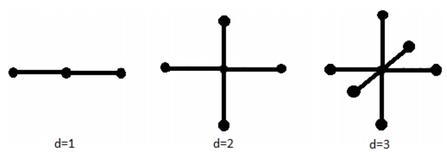
In the above model, disease results from the interaction between the agent and the susceptible host in an environment that supports transmission of the agent from a source to that host, according to possible sufficient causes.

Ising Model

The Ising model is concerned with the physics of phase transitions, which occur when a small change in a parameter causes a large-scale, qualitative change in the state of a system.

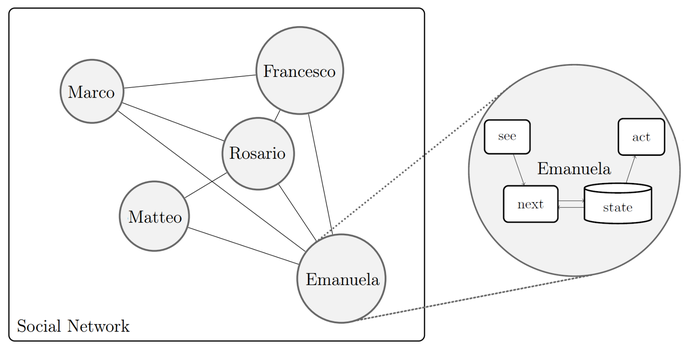
$$H = H(\sigma) = -\sum_{\langle i,j \rangle} E\sigma_i\sigma_j - \sum_i J\sigma_i$$

The Hamiltonian is the total energy of a system and it governs the dynamics of the Ising model.



The Ising model offers an inspiring formalism for considering the influence by external parameters (news) and from neighbours (friends).

Agent Based Modelling



In our model, an agent simulates the common activities of a social network user and how he is expected to interact within the environment, handled as a graph. Modelling such complex system requires a deep understanding of the dynamics behind the human actions, along with the users' personal information, like age, education, sex, leanings and so on.

jSEAGULL

jSeagull is addressed to everyone who needs to gain insights for what concerns news propagation within a social network. Once all files needed for topology construction and user feature assignment are provided, the program requires the definition of the specific piece of news to be propagated inside the network, permitting the specification of hashtags and a set of users to be tagged. In this manner, jSeagull builds up a model for this piece of news in such a way that the observer may visualise its potential impact on the network. This useful feature is reached by colouring each node of the network with respect to its own interest, with the possibility of coming back to the news creation phase in case of low rates. Afterwards, the observer can designate multiple initial nodes from which the news spread will start. Each social network user has been modelled as an adaptive agent with two different behaviours associated with him. The first one continuously checks if the piece of news has been notified by a neighbour, further verifying if the infection level is sufficient to consider the user infected. Afterwards, the user contagion will trigger the one-shot action associated to his own sharing behaviour, which will propagate the news in a certain way. Five different sharing behaviours have been modelled in order to reflect the typical kinds of users which can been encountered on a Social Network, namely: altruists, selectives, hipsters, phantoms and connectors.

Tag Distance Matrix

$D = R^{|t|\times|t|}$: indicates the shortest path among tag pairs.

$$D_{i,j} = \frac{1}{1 + Dijkstra(i,j)}$$

Interest rate

$I_{a,n}$: is the interest level on the news (n) from agent (a).

$$I_{a,n} = g\sum_{i=1}^{|n|} tag(a)D^{n_i} \qquad I_{a,n}^{new} = \frac{I_{a,n}^{old}}{\log_{20}(tick + base)}$$

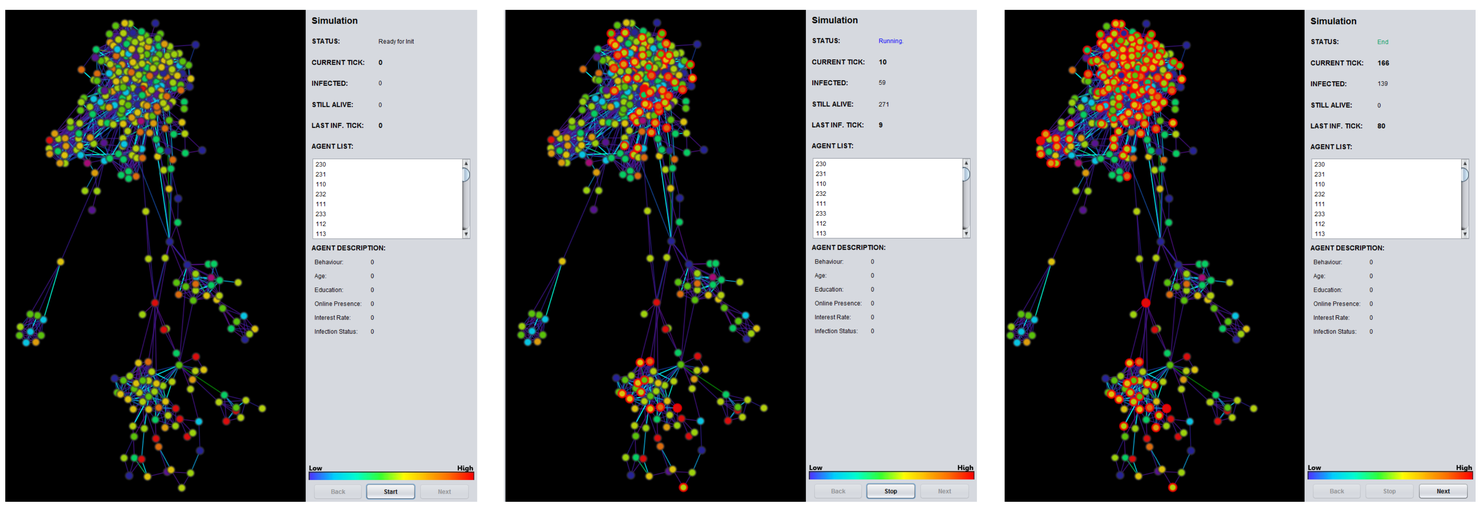
Affinity

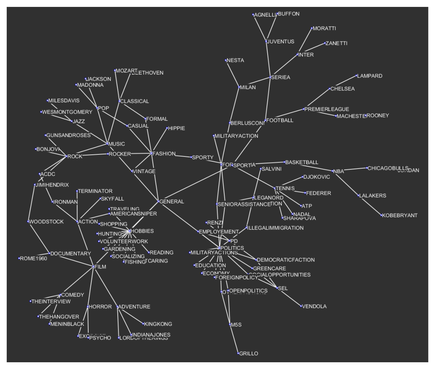
$A_{i,j}$: is the affinity level between two linked agents.

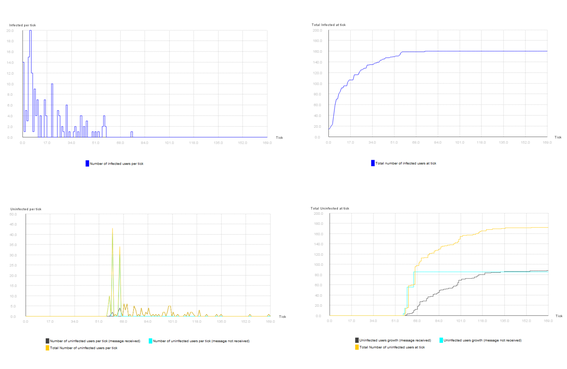
$$A_{i,j} = commonFeature(i,j) \times (commonCircle(i,j) + 1)$$

Susceptibility Factors

Factor Name	Maximal Δ Infection Level
Age	+10
Education	+15
Interest Rate	+60
Edge Weight	+40
User Tag	+15
Number of Message Received	+3 at each notification







Conclusions

This first release provides an accurate software environment intended to represent a news spread simulation within a social network. Surprisingly, the obtained results show an infection trend similar to the epidemiological ones, confirming a noteworthy correlation among them. We hope to develop a new jSeagull version able to exploit the enhanced computational capabilities of GPU computing, in such a way to manage a large number of agents. Furthermore, it could be a great advantage to provide more sharing behaviours with the possibility of combining them for a single user. Our current version of jSeagull is a first intent to put the basis for a continuous collaboration aimed to get a professional application suitable for real case studies.